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unfortunately the sun would be very far south, and therefore observers in the northern hemisphere would be excluded from favourably observing the transit. Astronomers, however, had devised several methods for taking the greatest advantage of the occasion. At the Astronomical Society a paper had been read by the Astronomer Royal, in which he had pointed out the positions from which the phenomena could be best observed. These stations being, for the most part, *in terris incognitis*, brought the subject within the legitimate domain of the Royal Geographical Society.

The following Paper was then read by the Author :—

*On Antarctic Discovery, and its Connexion with the Transit of Venus in 1882.* By Staff-Commander J. E. DAVIS, R.N., F.R.G.S.

[ABSTRACT.]

THE author prefaced his paper by stating that the Circumpolar Chart, exhibited by him in illustration of his subject, was compiled from many authorities, with a very considerable and important addition from the President of the Royal Society, in the curves of magnetic dip and declination, which were part of the results of many years of toil and study by General Sabine ; it was not, however, his purpose to allude to them that evening, but he was sure they were not misplaced, as they were of the deepest interest to the physical geographer. The materials for the diagrams in connection with the transit of Venus had been kindly furnished him by the Astronomer Royal previous to reading his late paper before the Royal Astronomical Society.

The paper commenced with a sketch of the history of discovery in Antarctic regions, the author believing that the public were not so well acquainted with South Polar as with Arctic explorations. While the names of Northern discoverers were “familiar in our mouths as household words,” but comparatively few had ever heard of those of the South ; and even the renowned Cook was more remembered for his discoveries in the Pacific than for his bold push towards the South. Had it not been for the coming transit of Venus in 1882, the Antarctic might have remained neglected for another century. A brief account was given of the various discoveries from that of South Shetland by Dirk Gerritz in 1599 to the voyage of Captain James Clark Ross. Cook made no discoveries in the South, but his voyage was of this consequence—we knew that for any large tract of land we must look further south. The expedition of Bellingshausen was, in like manner, of not so much importance from its discoveries as from its non-discoveries. Weddell, an officer in the Royal Navy, who in 1823 reached the high latitude of  $74^{\circ} 15'$ , deserved the greatest credit for venturing so far south in such small vessels at so late a period of the season. Whatever might be the

extent of our future discoveries in the South, the name of Weddell would ever hold its own for gallantry and daring. The voyages of Biscoe, Balleny, and Kemp, were then mentioned, and the discoveries made by them enumerated,—especially that of Enderby Land by Biscoe, and so named by him in honour of the enlightened and public-spirited merchant, Mr. Enderby, at whose cost his explorations were undertaken. The author then described the interest which was shown in the phenomena of terrestrial magnetism in 1838, which resulted in the Government fitting out the *Erebus* and *Terror*, for the purpose of pursuing the investigation in the southern seas, the command being given to the discoverer of the North Magnetic Pole, Captain J. C. Ross.

The ships left England in September, 1839, and, carrying on their magnetic observations through the voyage, arrived at Hobarton, Tasmania, in August, 1840. On his arrival, Captain Ross found that two expeditions—one French and the other American—had anticipated his intentions, and been south in the direction of the magnetic pole. The French expedition under Captain Dumont d'Urville, after discovering a portion of land on the Antarctic Circle, returned to Hobarton, having been absent seven weeks. The author then reviewed the evidence of the discoveries of land by Captain Wilkes, and explained the error into which that discoverer fell, in departing from the course usually adopted by navigators, of mapping such land only of which no doubt could exist, and leaving the remainder as “appearances” for confirmation or otherwise by others. Some portion of the land, he believed, really existed, and might safely take the place of the blank spaces upon our map. The merit of the discovery of the continent—if it be such—was due to Balleny, who mapped out “Sabrina Land” the previous year. Captain Ross's three voyages south were then described, and the barrier offered to further discovery, which ran east and west through 25 degrees of longitude. The highest southern latitude reached was  $78^{\circ} 10'$ .

The object sought by the observation of the transit was well known to be the ascertainment, to be deduced therefrom, of the exact distance of the earth from the sun—calculations of this distance at present varying to the extent of three or four millions of miles. The most simple mode of explaining the process by which this is to be accomplished was by stating that all that was required for the calculation was the exact angle subtended by the radius of the earth from the sun; and as we could not get to the sun for the purpose, it must of necessity be done from the earth by means of parallax, or the apparent change in the position of the sun by a change of posi-

tion on either side of the earth's centre, the amount of the sun's parallax in dispute causing the error in distance being but little more than the third of a second of an arc. We are assured by astronomers that the best mode of ascertaining the required distance is by observing the moment of ingress and egress of the planet on the sun's disk from opposite parts of the globe; and it was easy to understand that if the ingress and egress of the planet be observed from points of the meridian on either side of the centre of the illuminated side of the earth, the moment of contact would be accelerated in the one case, and retarded in the other; and that this acceleration and retardation would increase in ratio to the distances of the points of observation, being greatest at spots most divergent from the centre of the illuminated arc, or where the sun is on the horizon; but as it was not possible to observe it from those positions, a position as near to them as possible is to be obtained. There were two methods by which the transit could be effectually observed:—1st. By absolute longitudes from four stations, viz., one for acceleration by parallax, and one for retardation, for the ingress, and the same for the egress. For this method, accurate determinations of longitude were necessary—an error of *one* second in time would vitiate the result. The other method was by observing both ingress and egress from two stations—one for acceleration by parallax, the other for retardation; the great advantage of this method over the other being that the accurate determination of longitude was not an absolute necessity. In the transit of Venus in 1882 one such station was to be found in the North American colonies, but the other could be obtained only in a high southern latitude, and this brought the two parts of the subject together. The diagrams exhibited would show the relative value of a station parallactically, which was denoted by factors of which 1·0 represented the point of greatest value, and the decimals the lessening value; the highest altitude of the sun and the highest factor of parallax being the best position for observing the transit. Thus the normal point was useless, the sun being on the horizon, while at Capetown the parallactic value was too small. At Kerguelen's Island the altitude of the sun at the ingress would be about  $12^{\circ}$ , while the parallactic value is large (about 0·97); at Crozet's, altitude  $24^{\circ}$ , parallactic value 0·9, both very good stations; but another element had to be considered, viz., meteorology; and these stations, with those at other localities, as the Mauritius and islands near, were only adapted for the first method, and dependent on absolute longitude. By the diagrams it would be seen that if a position could be found in a high southern latitude, the second method could be adopted; and for this purpose

the Astronomer Royal had suggested two points—one near Sabrina Land, in seven hours East longitude, where the ingress and egress could be observed on either side of the nether pole, at an altitude of about  $5^{\circ}$ , the other on the coast of South Victoria, in latitude  $72^{\circ}$ , or in a higher latitude if possible. The first position was not propitious, as the high land would be immediately between the observer and the sun, and with the low altitude it was probable the sun would not be seen; but the other position afforded a better prospect of success: still there was one difficulty attached to that, viz., the utter impracticability of reaching it in time to make the observation, and time would be necessary to arrange the instruments, &c. But the author did not consider this difficulty insurmountable: it could be overcome by landing the party the previous summer in January, and by so doing the advantage to science would be great, as a valuable series of observations in meteorology and other branches, through an antarctic winter, would be obtained.

The *modus operandi* suggested by Captain Davis was that two vessels with steam-power (for which he deemed the hydraulic propeller worthy of consideration) should leave England in June, 1881, having on board the equipment, in men and instruments, for observing the transit by both methods; on the passage out the parties for the first method should be landed on the selected stations, and in December or January the ships would proceed south, in longitude about  $160^{\circ}$  East, working their way through the pack-ice towards South Victoria, pass Possession Island, and carefully examine Coulman Island, in latitude  $73\frac{3}{4}^{\circ}$ , and, failing to find a harbour or suitable position for landing on that island, return at once to Possession Island (where Sir James Ross effected a landing), and land the party with huts, instruments, and provisions for two years; the ships then returning north, and, after visiting the other observing parties, again proceed south about the same time as the previous year, and, after embarking the southern party, return and pick up the others and return to England. Regarding the stations meteorologically, the advantage was decidedly in favour of the southern ones, at which the chances of obtaining the observation or not were pretty evenly balanced. When fine, the atmosphere was so clear that mountains at a hundred miles' distance would readily be believed to be not more than twenty; while such navigators as had passed Kerguelen's or Crozet's had described them generally as being wrapped in a mantle of mist; and although it would be scarcely fair to draw conclusions from a winter residence, still, having been two to three months in that season at Kerguelen's, in which he had been absent

in an open boat for a fortnight, it had left vivid impressions of the humidity of the climate on the author's mind.

Of the value to be attached to the observation of the transit, astronomers could best judge; but in following the example of the Astronomer Royal, by quoting the words of his illustrious predecessor, Halley, the author could not do wrong:—"And heartily could I wish observations of this phenomenon to be made by several in divers localities—as much for the establishment of a firmer belief through a general agreement as lest a single observer should be frustrated by intervening clouds—of such a spectacle as I know not that men of this or the following age will again see, and upon which depends the certain and satisfactory solution of a most remarkable and otherwise insolvable problem. And to such subtle examiners of the heavenly bodies, after our decease, are the observanda committed; again and again do we commend to them that, encouraged by the memory of this work of ours, they should strenuously—even with their whole powers—apply themselves to the thorough fulfilment of the observation, and for them we devoutly pray and wish all propitious circumstances; above all, that they may not be deprived of their most anxiously desired view by an inopportune obscuration from a clouded sky; and that, finally, the discovery of the magnitudes comprised within the narrower limits may redound to their lasting honour and glory."

If this great national work, of which we were to be so proud, this remarkable and otherwise insolvable problem, was to be accomplished, it was Captain Davis's opinion that those who were to be instrumental in its accomplishment should go to school at once, and *that school* was the *North*. Without previous experience in ice-navigation in the North, would Sir James Ross have been so successful in the South? His firm belief was that every man in that Southern expedition that had not previous experience would have turned back; he would have done so himself. No doubt in 1881 many would be ready and willing to go, but he did them no injustice in saying that, without previous experience in ice-navigation, the voyage would prove a failure; and now that North Polar research was revived, and foreigners were straining every nerve to reach the Pole, was England not to make an effort to hold her own? He trusted that an expedition would soon be sent, and all looked to the Royal Geographical Society as the lever to produce the movement; shame would be on us if a foreigner were to step in and carry off our Polar honours; but it would not do to think of, and he trusted that, even in this utilitarian age, some men in power would be

found who did not consider money thrown away to advance Geographical knowledge, who would advocate the cause of polar discovery, and keep up the breed of polar men who added so much to the peaceful honours of our country.

The Paper will be published *in extenso*, with chart and diagrams, in the 'Journal,' vol. xxxix.

Captain RICHARDS (Hydrographer to the Admiralty) said the question brought before the meeting had been fully considered in an astronomical point of view by Professor Airy, and discussed at a late meeting of the Astronomical Society. It was the business of the astronomer in such cases to point out what the geographer was to do. This duty had been performed by the Astronomer Royal, and he had no doubt that when the necessity arose the Government would respond to those suggestions. The transit of 1882 was yet a long way off, and there was therefore, humanly speaking, plenty of time to prepare for it. If it be necessary in 1882 or 1881 to go to the Antarctic continent, he had no doubt that the Government would be prepared to carry out the undertaking. But it must be remembered that circumstances were different now from what they were when the *Erebus* and *Terror* were sent out to find the North-West Passage. The Admiralty could send out such an expedition in those days, but these undertakings were not now among its functions. Whether or not such enterprises were carried out in the present day rested with the country at large. Naval officers were not less ready than formerly to go the South Pole or to the North Pole, but it did not rest with them. However, he had no doubt but that the country which sent out the expedition to observe the transit of Venus in 1769 would be prepared to act in a similar spirit in 1882. He was not warranted or authorised to say what the Admiralty would do in the matter, but he was persuaded that they would do everything in their power to carry out the project which had been recommended.

Captain SHERARD OSBORN had been for some months collecting data for a paper upon the same subject as that which they were then discussing. He was, however, delighted to find it dealt with by one who, from having been an actor in the scenes he had described, wrote *con amore* of the region in which he had played so prominent a part. No doubt, when the time arrived, men would be found willing to go, but still the necessary experience might be wanting. He agreed with the writer of the paper that such experience must be acquired in the North, where Ross attained that knowledge which enabled him to proceed so far towards that south pole which they would soon be wanting to reach. Instead of keeping our navy, as at present, ever at anchor, it would be far better to send our sailor officers to learn endurance amid the hardships of the polar regions. Though we were allowing the Swedes and Germans at present to lead the way, he trusted the day was not far distant when the Geographical Society would put its shoulder to the wheel to induce the Government to send out an expedition again. One hundred years ago, when George III. was king, the First Lord of the Admiralty, addressing Commodore Byron, particularly alluded to the happy circumstance that his Majesty's kingdom was then enjoying a long peace, and that as there were certain continents and islands in the great Southern Sea worthy of being discovered and explored, and brought to human ken, he was of opinion that the opportunity should be turned to account. Cook was subsequently sent out, and well it was for the world, and better still for England, that such was the case. Looking at the proposed expedition which the Hydrographer seemed to promise should one day be sent out, he hoped that the expedition when sent to the Antarctic regions

would be empowered not only to observe the transit of Venus, but to make a wider exploration like that of Cook, and so to bring home to us a more extended knowledge of the geography of the Southern Hemisphere, and especially of that science of which we are only at the threshold—the geography of the sea.

Admiral COLLINSON said he quite agreed with Captain Davis that it was absolutely necessary the expedition should be landed the previous summer. He did not think it would be advisable to send out ships with the idea of their wintering there; but he could not see any objection to the party remaining, as previous observations had proved that there was an abundance of fresh food to be obtained. But the most important point of all was that of the positive necessity of educating men to the work. If men were sent there who had not previously experienced what ice-navigation was, the expedition would turn out to be a failure. He therefore sincerely hoped that the Society would urge upon the Government the necessity of maintaining that acquaintance with ice-navigation which had so long tended to the honour, the credit, and the renown of this country.

Sir L. M'CLINTOCK was glad of the opportunity of joining in the recommendation that those who are hereafter to carry out the interesting undertaking which they had met to consider, should now be sent to the North, so that experienced officers may not be wanting when their services are required. He himself should be sorry in thirteen years' time to have to make an antarctic voyage, as he considered that he would then be past the age when he could conduct it in a manner honourable to himself or beneficial to the country; but he was quite ready to start now, if necessary, with ships of instruction, taking a number of young lieutenants who were lingering about at home, and teach them how work was to be done in the ice regions.

Admiral Sir E. BELCHER said it was originally arranged between Sir James Ross and himself that whenever the antarctic expedition was fitted out he (Sir E. Belcher) should be the second in command, but the Chinese war prevented the fulfilment of their intentions. He was perfectly satisfied that during the time the sun is above the horizon the expedition would find the atmosphere of the antarctic regions clear, and find every facility for carrying on their observations. He agreed with Captain Osborn that it was advisable at once to begin to educate men for the work; but he could not forget that Parry and Ross, and many other celebrated voyagers, did their work manfully and well in the arctic regions on the first occasion without having had previous experience. Sir L. M'Clintock had said he should not like to be sent away to the polar regions thirteen years hence, but he (Sir E. Belcher) would be quite ready to go. He was not yet so old as Franklin was when he started on his last expedition, but the latter never turned round and said he was too old. He was perfectly satisfied that when the occasion arose men would be found to do the work as well as if not better than such work had ever before been done.

Dr. RAE thought it was evident that some experience was needed for such work as the expedition would be called on to perform, because those explorers who had not been accustomed to arctic voyaging had invariably taken whaling men to show them how to manage the vessel. It was not an easy thing to manage a ship or boat in ice-navigation. A man need to be prepared to work the vessel at a moment's notice in such a manner as to clear a sudden danger, and to be ready for everything. A man going to the arctic regions should be of that period of life when he was full of energy and capable of enduring great hardships and privations, so as to enable him to be the actual as well as nominal leader of his men in all cases when great powers of endurance were called for. It was all very well so long as he could remain in the ship, but when he was compelled to take to the land the case was very different. He (Dr. Rae) had been told that, before Sir John Franklin started on his last cruise he was asked how he would manage if the ships were lost. His answer



was "Then I am a gone man," because he knew he would not be able to endure the privations of a land journey.

General LEFROY after remarking on his good fortune in meeting on that occasion with an old comrade of the *Terror* (Commander Davis) from whom he had parted thirty years ago, and whom he had not seen in the interval, said he wished to refer to that portion of the paper in which reference had been made to the American Antarctic Expedition. He had the good fortune to meet Commodore Wilkes in Washington, in 1842, and to hear from his own lips an account of his discoveries, and he now claimed for that eminent officer some reasonable degree of credit. He was convinced that Commodore Wilkes was perfectly sincere, and guided by the impressions of himself and fellow voyagers in laying down on his chart appearances of land. That he was not far wrong was proved by the fact that the coast line, as he marked it out, varied but little from that which had been ascertained to be the real truth. With regard to the national sense of the importance of observing the transit of Venus on the South Polar continent he considered that much was yet to be done to arouse public opinion in this country. To count the cost in a narrow spirit was unworthy of our national greatness.

Admiral OMMANNEY thought this subject had not been brought before the public one hour too soon. No school had trained so many valuable officers as that of arctic and antarctic explorations. He deplored the fact that there was nothing at the present day to remind the nation of the services rendered to his country by Sir James Ross, one of the greatest navigators of this century,—the man who discovered the north magnetic pole. Such a state of things was disgraceful to the nation. The portrait of Cook might be seen in the Hall at Greenwich, but nothing was there to remind the public of Sir James Ross. He hoped the Geographical Society would not long hesitate to do something to commemorate the services of that great navigator.

The CHAIRMAN informed the Meeting that quite recently the French Government had appealed to the Academy of Sciences for their opinion as to the most suitable localities for observing the transit of Venus in 1882, and the preparations required for that purpose. They would, therefore, agree that the subject had not been introduced a day too early.

Commander DAVIS, in reply, said he entirely differed from Admiral Belcher in the view he took as to the want of experience for such an expedition as that which was now proposed. If the opinions of arctic voyagers were taken, they would be found generally to coincide in the view that the command should be given to a man under fifty years of age. With regard to General Lefroy's observations on the discoveries of Commodore Wilkes, all he (Commander Davis) wished to say was that the American officer had recorded appearances of land as *terra firma*. Had he carefully marked the supposed discoveries as appearances of land, his account would not have been open to the objection which had been raised.

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